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Abstract

Evolution of the Shape of Detached GeSi Crystals in Microgravity

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A series of GeSi crystal growth experiments are planned to be conducted in the Low Gradient Furnace (LGF) onboard the International Space Station. An objective of these experiments is to understand the mechanisms of detached Bridgman growth, a process in which a gap exists between the growing semiconductor crystal and the crucible wall. Crystals grown without wall contact have superior quality to otherwise similar crystals grown in direct contact with a container, especially with respect to impurity incorporation, formation of dislocations, and residual stress in crystals. Numerical calculations are used to determine the conditions in which a gap can exist. According to crystal shape stability theory, only some of these gap widths will be dynamically stable. Beginning with a crystal diameter that differs from stable conditions, the transient crystal growth process is analyzed. In microgravity, dynamic stability depends only on capillary effects and is decoupled from heat transfer. Depending on the initial conditions and growth parameters, the crystal shape will evolve towards the crucible wall, towards a stable gap width, or towards the center of the crucible, collapsing the meniscus.